# Contributions to load efficiency in a computer cluster environment for an oblique subduction tentative modelling.

Mihai Pomeran[1], Lucian Beșuțiu[1], and Luminița Zlăgnean[1]

[1] *Institute of Geodynamics of the Romanian Academy, Address: 19-21 Jean-Louis Calderon St., Bucharest-37, Romania, R-020032; corresponding address: mihai.pomeran@gmail.com*

#### Abstract

Despite the increasing power of computer clusters employed for numerical modelling of Earth's interior dynamics, reducing the computing time therefore optimizing the operation costs still represents a challenge.

The paper aims to improve the knowledge about the role of the mapping process that shares the computing load among the individual processors of a computer cluster. We base our work on the idea that the mapping stencil should take into account the peculiarities of the simulation (e.g. the gradient of the studied physical quantity).

To run our computations, we use the CitcomS[1] finite element software package, installed at the CYBERDYN cybernetic infrastructure (CCI) owned by the Solid Earth Dynamics Department in the Institute of Geodynamics of the Romanian Academy. CCI is a modern Beowulf-type high performance computer cluster, combined with a high performance visualization cluster and a 3D stereoscopic projection system. CCI's architecture is structured around 1344 central processing unit (CPU) cores and 3 TB of random access memory (RAM). The high speed interconnect is provided by a Qlogic InfiniBand switch, able to transfer up to 40 Gbps. The CCI storage component is a 40 TB Panasas network attached storage (NAS).

The considered scenario has been an oblique subduction. Two identical tectonic plates converge towards each other on the longitude direction, for a period of 30 Myr (model time). Then, an assumed pole jump of one plate changes the velocity vector field and as a result the tectonic plate increases its speed along the trench. When computation time ended (1000 numerical steps) 55 Myr of model time had passed, the structure of the subduction zone revealed a slab that appeared flat on one side of the model and steep on the other side, similar to that described by the CitcomS tutorial.

The 3D model spanned within a spherical domain of $1274.2 \times 3185.5Km$ lat×long or $11.46° \times 28.65°$ lat×long, reaching $1900Km$ in depth. To solve the equations we employed a irregular numerical grid with higher resolution towards the middle and the top of the of the computing domain.

To test our assumptions, we equally shared the 32768 finite elements of the model among CPUs, but in different ways. By analyzing the execution and model time of each simulation, we have succeeded to find the optimum direction for the mapping stencil to distribute the CPU cores on. This way, the computing time is significantly smaller. The shortest execution time was less than half: 40% from the average execution time and 12.5% from the longest.

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**Key words** : computational geodynamics; HPCC; computing time; subduction;

[1] *CitcomS*: **C**alifornia **I**nstitute of **T**echnology **Co**nvection in the **M**antle - **S**pherical; www.geodynamics.org